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Abstract

**INTEGRATION OF NUCLEAR REACTORS AND POWER NETWORKS
IN THE UNITED STATES; ECONOMIC AND TECHNICAL ASPECTS**

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Primary considerations in the selection of an energy source for an electric generating station are: (1) cost - of competitive heat and power supplies; (2) dependability - that electricity will always be ready; (3) availability - in any quantity to anyone who may desire it at any location; (4) economy - in operation and use; and (5) quality - to meet the existing voltage and frequency regulation demands of modern equipment and controls.

Freedom in selecting primary energy sources is increased by the existence of large regional electrical networks which interchange power on an economy as well as an emergency basis. Network operation (81% of this country's generating facilities are tied together in one interconnection and the remainder are in a second network) helps smooth the peaks and valleys of demand but also places a more insistent call on individual generating stations to follow closely power swings and surges.

In view of the high capital investment needed for a modern electric generating station, the question of timing becomes very important. It is desirable to bring a new station on stream at the exact time when reserve capacity reaches the minimum compatible with supplying quality service. Optimum reserve margins vary between 10 and 15% of total system capacity and are often established by statistical techniques rather than fixed percentages.

Energy sources for base load stations, in addition to nuclear, are primarily fuel oil and coal in the coastal states; oil and gas in the southwest; hydro in the northwest and coal in the remaining areas. The size and location of the market for individual fuels has been changing rapidly in the past two years due to new concepts in transportation of

the fuel, such as integral trains, pipelines, conveyors and turn-around barges; and in transmission of power at voltages of 500 KV and above.

The optimum location of a base station is the point where line losses can be minimized and voltage maintained at a constant standard. This point must be correlated with land availability, safety and air pollution. After balancing all of the above factors, the ultimate decision becomes one of the cost of a kilowatt at the customer's meter. Generally, this cost is divided into fixed and operating costs, with a very small percentage going to administrative and general management expense.

Fixed costs include interest on funds borrowed for construction, depreciation, taxes and insurance and vary from 10 to 14% of the plant investment annually over the amortized life (30-50 years) for investor-owned utilities. Fixed costs for government plants vary from 5 to 7% annually. This difference in fixed costs tends to make development of any power facilities superficially more attractive to the government sector than to the private sector as the former pays less interest on borrowed money and, of course, is exempt from taxes, thus shifting the power cost in part to the taxpayer rather than the consumer.

Operating costs are sub-divided as follows: operating labor and supplies; maintenance, labor and materials; and fuel costs, including purchase price, transportation and handling charges. By relating fuel costs to heat value, consideration is given to developments in fuel processing and handling. For nuclear, this involves private ownership of fuel and gains in breeder technology. For fossil fuel it includes lowering of transportation costs as well as improvements in technology, such as higher temperatures and pressures, which will increase boiler efficiency.

Although difficult to evaluate, final consideration must be given to future availability of the primary energy source, that is, whether coal, oil, uranium and/or plutonium be available in adequate quantities at satisfactory cost levels until amortization of the specific plant has been completed.